REMARKS

Please reconsider this application in view of the following remarks. Applicant thanks the Examiner for carefully considering this application.

Disposition of Claims

Claims 1-5, 7-11, and 13-15 are currently pending in this application. Claims 1 and 9 are independent. The remaining claims depend, directly or indirectly, from claim 1 or 9.

Rejection(s) Under 35 U.S.C. § 103(a)

Claims 1-3, 7, 8, 11, and 13 are rejected under 35 U.S.C. § 103 (a) as being unpatentable over U.S. Patent No. 6,441,403 ("Chang") and U.S. Patent No. 4,992,837 ("Sakai") in view of U.S. Patent Publication No. 2002/0093020 ("Edmond") and further in view of U.S. Patent No. 5,684,309 ("McIntosh"). For the reasons set forth below, this rejection is respectfully traversed.

One or more embodiments of the claimed invention are directed to a gallium nitride (GaN)-based compound semiconductor device. With reference to Figures 1 and 2, for example, the GaN-based compound semiconductor device has a GaN-based light emitting member 24 and a buffer layer 22. The light emitting member 24 further has a multilayer quantum well structure. Specifically, the light emitting member 24 has an InGaN well layer 24b and an AlInGaN barrier layer 24a. The compositional ratio of Al in the AlInGaN barrier layer 24a is 14% or greater and 40% or smaller, and the compositional ratio of In in the AlInGaN barrier layer 24a is 0.1% or greater and 5% or smaller. As a result, the light emission efficiency of the GaN-based

compound semiconductor device becomes 2.6 times greater, and the GaN-based compound semiconductor device can provide a light emission whose wavelength is 375nm or shorter (*see, e.g.,* publication of the Specification, paragraphs [0004] and [0032]).

Accordingly, independent claim 1 requires, in part, the limitations, (i) a compositional ratio of Al in the AlInGaN barrier layer is 14% or greater and 40% or smaller, and a compositional ratio of In in the AlInGaN barrier layer is 0.1% or greater and 5% or smaller and (ii) the GaN-based light emitting member emits ultraviolet light having a wavelength of 375 nm or shorter.

In contrast, Chang, Sakai, Edmond, and McIntosh, whether considered separately or in combination, fail to show or suggest at least the above limitations.

At the outset, as acknowledged by the Examiner, Chang fails to show or suggest the specific composition ratio and the specific wavelength as claimed (*see* pending Office Action, page 3). In fact, Chang generally teaches an AlInGaN buffer layer without teaching a specific composition ratio of Al and In in the AlInGaN buffer layer. Also, Chang is completely silent with respect to a specific wavelength of a light emitted from the light emitting device. Accordingly, Chang fails to show or suggest at least the above limitations. Sakai also fails to show or suggest at least the above limitations. In fact, Sakai teaches nothing more than a super-lattice structure of an active layer and clad layers (*see* Sakai, column 7, lines 7-11). Sakai is completely silent with respect to a specific composition ratio of Al and In in the AlInGaN barrier layer and a wavelength of a light emitted from the light emitting device.

Edmond fails to supply that which Chang and Sakai lack. In fact, Edmond only teaches that because characteristics of Group III nitrides differ based on mole fraction of Group III elements, adjusting of the mole fraction is necessary (*see* Edmond, paragraph [0025]). Thus, Edmond is completely silent with respect to the *specific composition ratio* of Al and In in the

AlInGaN barrier layer as claimed. Accordingly, Edmond fails to show or suggest at least the limitation (i) a compositional ratio of Al in the AlInGaN barrier layer is 14% or greater and 40% or smaller, and a compositional ratio of In in the AlInGaN barrier layer is 0.1% or greater and 5% or smaller, as required by independent claim 1.

Further, Edmond clearly states "[t]he present invention relates to semiconductor structures of light emitting devices. . . which are capable of emitting light in the *red to ultraviolet portions of the electromagnetic spectrum*" (*see* Edmond, paragraph [0002]). That is, Edmond is only directed to a semiconductor structure for emitting light *in the red to ultraviolet spectrum* (*see* Edmond, paragraph [0002], claims 1 and 22 and abstract). Further, Edmond only teaches the wavelength of light is based on an energy bandgap (*see* Edmond, paragraph [0006]). Thus, it would be clear to a skilled artisan that Edmond does not teach the *specific wavelength* as claimed. Therefore, Edmond fails to show or suggest at least the limitation (ii) the GaN-based light emitting member emits *ultraviolet light having a wavelength of 375 nm or shorter*, as required by independent claim 1.

McIntosh fails to supply that which Chang and Sakai lack. In fact, McIntosh only teaches that the barrier layers 11a, 11b, and 11c may be formed on aluminum gallium nitride or aluminum indium gallium nitride (*see* Edmond, column 5, lines 1-5). Thus, McIntosh is completely silent with respect to the *specific composition ratio* of Al and In in the AlInGaN barrier layer as claimed. Therefore, McIntosh fails to show or suggest at least the limitation (i) a compositional ratio of Al in the AlInGaN barrier layer is 14% or greater and 40% or smaller, and a compositional ratio of In in the AlInGaN barrier layer is 0.1% or greater and 5% or smaller, as required by independent claim 1.

Further, McIntosh is directed to a light emitting diode for emitting light *in the red to ultraviolet spectrum.* Specifically, McIntosh teaches that the LED is not generally available as a

replacement of a white light source. Then, McIntosh teaches that an object of the invention is providing a light emitting diode emitting white light. McIntosh further teaches the aluminum indium gallium nitride material system possessing an energy bandgap that are tailored over *wavelength ranging from fur ultraviolet to red region of electromagnetic spectrum* (*see* McIntosh, column 1, lines 19-56 and column 2 lines 7-13). Thus, it would be clear to a skilled artisan that McIntosh does not teach the *specific wavelength* as claimed. Therefore, McIntosh fails to show or suggest at least the limitation (ii) the GaN-based light emitting member emits *ultraviolet light having a wavelength of 375 nm or shorter*, as required by independent claim 1.

Accordingly, Chang, Sakai, Edmond, and McIntosh, whether considered separately or in combination, fail to show or suggest the limitations, (i) a compositional ratio of Al in the AlInGaN barrier layer is *14% or greater and 40% or smaller*, and a compositional ratio of In in the AlInGaN barrier layer is *0.1% or greater and 5% or smaller* and (ii) the GaN-based light emitting member emits ultraviolet light having *a wavelength of 375 nm or shorter*, as required by independent claim 1.

Turning to the rejection, the Examiner alleges that Edmond makes it clear that the content of Al and In in an Group III nitride layer is a result effective variable, and, thus, the specific compositional ratios of Al and In as claimed are not patentably distinguishable over Chang, Sakai, and Edmond (*see* pending Office Action, at page 3). The Examiner also alleges that the specific composition ratio and the specific wave length as claimed are mere discovery of optimum ranges or workable ranges based on routine experimentation in view of McIntosh (*see* pending Office Action, page 4). Applicant respectfully disagrees for the following reasons.

MPEP makes it clear that "[a] particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine

experimentation" (*see In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977)). Applicant respectfully asserts that the specific compositional ratios of Al and In and the specific wavelength as claimed are neither a result effective variable nor mere discovery of optimum ranges or workable ranges based on routine experimentation in view of Edmond or McIntosh.

As explained above, Edmond is clearly directed to a semiconductor structure for emitting light *in the red to ultraviolet spectrum* (*see* Edmond, claims 1 and 22, abstract, paragraph [0002]). Similarly to Edmond, McIntosh is directed to a light emitting diode for emitting light *in the red to ultraviolet spectrum* as discussed above. Thus, a skilled artisan would readily recognize that Edmond and McIntosh are directed to emitting a light having a *wide spectrum* and are not directed to emitting a light having a *wavelength of 375nm or shorter with high efficiency*. Accordingly, the skilled artisan would not recognize the result that the claimed invention achieves *2.6 times greater efficiency of a light emission whose wavelength is 375 nm or shorter* as a *result effective variable* from the teachings of Edmond or McIntosh. Also, it would be clear to the skilled artisan that the specific composition ratio to emit a light having such wavelength with high efficiency is not *mere discovery of optimum ranges or workable ranges based on routine experimentation* in view of Edmond or McIntosh.

Moreover, Applicant respectfully asserts that the invention recited in independent claim 1 achieves *new and unexpected results* in that a GaN-based compound semiconductor device as recited in the claims emits a light that has a *wavelength between 340-375 nm* (*see* publication of the Specification, column 4, paragraph [0038]). As described in the present specification, a skilled artisan at the time of the present invention would have recognized that, in view of prior art, "fundamentally, when InGaN is used as the light emitting layer, *light emission of 363 nm or shorter cannot be achieved*" (*see* publication of the Specification, column 1, paragraph [0003]). Also, a skilled artisan at the time of the present invention would have recognized that achieving

a light whose wavelength is 375 nm or shorter results in reducing an efficiency of the light emission (*see, e.g.,* publication of the Specification, paragraphs [0002] and [0003]).

MPEP makes it clear that Applicant can rebut a *prima facie* case of obviousness based on a claimed invention by showing that there are new and unexpected results relative to the prior art (*see* MPEP § 2144.05). Accordingly, Applicant respectfully asserts that the invention recited in independent claim 1 achieves new and unexpected results relative to the prior art.

Furthermore, Applicant respectfully asserts that amended independent claim 1 recites a novel and non-obvious specific range that solves a *long-felt need* that was left unresolved by the prior art. As described in the present specification, a skilled artisan at the time of the present invention would have recognized that, in view of prior art, "*there have been a active efforts* to develop LEDs having a short wavelength of 375 nm or shorter or having an ultraviolet (UV) wavelength. *Demand for such short wavelength LEDs is very strong*" (*see* publication of the Specification, column 1, paragraph [0003]). However, as explained above, "fundamentally, when InGaN is used as the light emitting layer, *light emission of 363 nm or shorter cannot be achieved"* (*see* publication of the Specification, column 1, paragraph [0003]). Further, to realize a light emission whose wavelength is 375 nm or shorter results in reducing an efficiency of the light emission (*see, e.g.,* publication of the Specification, paragraphs [0002] and [0003]). Thus, the invention recited in independent claim 1 addresses this long-felt need (among other things).

MPEP requires the Examiner to consider such a long-felt need as a relevant factor in any obviousness determination (*see* MPEP § 2141). Thus, Applicant respectfully asserts that amended independent claim 1 recites a novel and non-obvious specific range that solves a long-felt need that was left unresolved by the prior art.

Finally, Applicant respectfully asserts that the characterization of certain claim limitations or parameters as obvious does not make the claimed invention, considered *as a whole*, obvious. It is incumbent upon the Examiner to establish a factual basis to support the legal conclusion of obviousness (*see In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988)). This burden can only be satisfied by an objective teaching in the prior art or by cogent reasoning that the knowledge is available to one of ordinary skill in the art (*see In re Lalu*, (747 F.2d 703, 223 U.S.P.Q. 1257 (Fed. Cir. 1984)). Further, in *KSR Int 'l Co. v. Teleflex Inc.*, 127 S.Ct. 1727 (2007), the Supreme Court noted that the analysis supporting a rejection under 35 U.S.C. § 103 should be made explicit. Hence, the key to supporting any rejection under § 103 is the clear articulation of the reason(s) why the claimed invention would have been obvious (*see* MPEP §§ 2141, 2142). For all the foregoing reasons as explained above, Applicant respectfully asserts that the pending Office Action fails to provide proper reasons why the claimed invention would have been obvious.

In view of above, Chang, Sakai, Edmond, and McIntosh, whether taken separately or in combination, fail to show or suggest the invention as recited in independent claim 1. Thus, independent claim 1 is patentable over Chang, Sakai, Edmond, and McIntosh. Dependent claims are allowable for at least same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

Claims 4 and 5 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Chang, Sakai, Edmond, and McIntosh in view of U.S. Patent No. 5,543,638 ("Nettelbladt"). For the reasons set forth below, this rejection is respectfully traversed.

As explained above, Chang, Sakai, Edmond, and McIntosh, whether taken separately or in combination, fail to show or suggest the invention as recited in independent claim 1.

Nettelbladt fails to supply that which Chang, Sakai, Edmond, and McIntosh lack. In fact, Nettelbladt teaches nothing more than that the fundamental wavelength of the quantum well is determined by the energy bandgap of the material and the thickness of the material (*see* Nettelbladt, column 4, lines 8-10).

Accordingly, Chang, Sakai, Edmond, McIntosh, and Nettelbladt, whether considered separately or in combination, fail to show or suggest the limitations, (i) a compositional ratio of Al in the AlInGaN barrier layer is 14% or greater and 40% or smaller, and a compositional ratio of In in the AlInGaN barrier layer is 0.1% or greater and 5% or smaller and (ii) the GaN-based light emitting member emits ultraviolet light having a wavelength of 375 nm or shorter, as required by independent claim 1.

In view of above, independent claim 1 is patentable over Chang, Sakai, Edmond, McIntosh, and Nettelbladt. Claims 4 and 5 are allowable for at least same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

Claims 9 and 10 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Chang in view of Sakai and further in view of Edmond.

Independent claim 9 requires, in part, "a compositional ratio of Al in the AlInGaN barrier layer is 14% or greater and 40% or smaller, and a compositional ratio of In in the AlInGaN barrier layer is 0.1% or greater and 5% or smaller" and "the GaN-based light emitting member emits ultraviolet light having a wavelength of 375 nm or shorter."

In view of the similarity between the limitations of independent claim 9 and the limitations discussed above with respect to independent claim 1, Applicant respectfully submits that the foregoing arguments as to the patentability of independent claim 1 also demonstrate the patentability of independent claim 9. As such, it is respectfully submitted that independent

claim 9 are patentably distinguishable over the cited references at least for reasons analogous to those presented above. Claim 10 is allowable for at least same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

Claims 14 and 15 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Chang in view of Sakai and Edmond and further in view of U.S. Patent Publication No. 2003/0047744 ("Yanamoto").

As explained above, Chang, Sakai, and Edmond, whether taken separately or in combination, fail to show or suggest the invention as recited in independent claim 1.

Yanamoto fails to supply that which Chang, Sakai, and Edmond lack. In fact, Yanamoto only teaches p-type and n-type clad layer composed of ALGaN (*see* Yanamoto, paragraphs [0070]-[0072] and [0081-[0083]).

Accordingly, Chang, Sakai, Edmond, and Yanamoto, whether considered separately or in combination, fail to show or suggest the limitations, (i) a compositional ratio of Al in the AlInGaN barrier layer is 14% or greater and 40% or smaller, and a compositional ratio of In in the AlInGaN barrier layer is 0.1% or greater and 5% or smaller and (ii) the GaN-based light emitting member emits ultraviolet light having a wavelength of 375 nm or shorter, as required by independent claim 1.

In view of above, independent claim 1 is patentable over Chang, Sakai, Edmond, and Yanamoto. Claims 14 and 15 are allowable for at least same reasons. Accordingly, withdrawal of this rejection is respectfully requested.

Conclusion

Applicant believes this reply is fully responsive to all outstanding issues and places this application in condition for allowance. If this belief is incorrect, or other issues arise, the Examiner is encouraged to contact the undersigned or his associates at the telephone number listed below. Please apply any charges not covered, or any credits, to Deposit Account 50-0591, Reference No. 08228/071001.

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Respectfully submitted,

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